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ABSTRACT

This study sought to investigate effects of a dance program on bilateral toe-standing balance and single-point static balance skills of a group of children with Down Syndrome. Thirteen experimental and 10 control group students between the ages of 3 and 13 years were assessed on toe-standing balance and single-point standing balance on the right and then the left lower extremities, with eyes open. It was hypothesized that a specially designed dance curriculum which integrated dance and traditional physical therapy facilitation techniques could benefit children with Down Syndrome because of the combined inherent cognitive and motor effects of the two modalities. A semiweekly dance and physical therapy program was conducted for 6 months, with each session including warm-up, ballet, and tap or tumbling activities. The program incorporated tactile guidance, voluntary control, rhythm, and repetition with vision and audition to enhance motor learning. A pretest-posttest procedure showed that balance scores were improved significantly in the experimental group compared to the control group. (JDD)

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Dance Therapy with Physical Therapy for Children with Down Syndrome.

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ABSTRACT

It was hypothesized that a specially designed dance curriculum which integrated dance and traditional physical therapy facilitation techniques could benefit children with Down Syndrome because of the combined inherent cognitive and motor effects of the two modalities. The purpose of this study was to investigate effects of a dance program on bilateral toe-standing balance and single-point static balance skills of a group of children with Down Syndrome (10, 12, 13). These are two areas which have been identified in the literature as areas of significant delay in children with Down Syndrome. Thirteen experimental and ten control group volunteers between the ages of 3 and 13 years were assessed using a stop watch to time toe standing balance and single-point standing balance on the right, then left lower extremities with eyes open. The experimental group of children participated for six months in the biweekly program while the control group maintained their regular physical education class schedule. All subjects had Down Syndrome and attended a school for trainably mentally handicapped children. A multiple regression analysis of covariance using original pretest scores as the covariables found the bilateral toe standing and single-point balance scores to be improved significantly in the experimental group ($F = 26.9$, $p < .0001$) when compared to the control group. Physical therapists should be aware that a small group program incorporating therapeutic facilitation, music, and dance activities can be of benefit to certain standing balance abilities of children with Down Syndrome.

REVIEW OF LITERATURE

Motor Control in Children with Down Syndrome

Down Syndrome (DS) (Trisomy 21) is a genetic disorder that occurs in one of every 660 live births (1). The condition is characterized by various physical anomalies. Motor deficiencies of children with DS include hyporeflexia, persistent primitive reflexes, muscular weakness, postural instability, joint hyperextensibility, pelvic hypoplasia, atlantoaxial ligamentous laxity, convergent strabismus, nystagmus, persistent palmar and plantar grasp, severe head lag, and lack of full antigravity extension (2, 3). Most children with DS are retarded, but the variability in intellectual function varies from moderate to severe (2). Similarly, there is more variability in the sensorimotor performance of infants with DS than is typically found in non-retarded individuals (4, 5). Seyfort and Spreen suggested that children with DS cannot form motor programs without visual and kinesthetic feedback (6). This finding was substantiated by Shumway-Cook who found that the normal anticipatory coactivation of postural muscles before the onset of a voluntary limb movement, usually the result of feed forward mechanisms, did not occur in children with DS (7). Instead of using the normal feed forward mechanism, children with DS were only able to attempt the movement and then use feedback from the movement. Lincoln, et al., found children with DS had significantly delayed visual and auditory reaction times when compared to chronologically and mental age-matched children (8).

They found that the stimulus was received at the same latency as controls, yet the motor portion of the response time was delayed. In

normal children to decrease response time due to a slow motor portion response practice is necessary. However, because children with DS might also have decreased motor memory according to Lincoln a stimulus is interpreted as novel over even more repetitions than in normal children. The reaction time, therefore, is not effectively reduced in children with Down Syndrome unless many repetitions are done (8).

MacNeill-Shea and Mezzomo found that balance experience and practice may be the crucial determinant of development in postural stability in children with DS because of neuromuscular imbalance at the ankle joint (9). LeBlanc, et al., and Henderson used the Cratty Gross Motor Test to examine motor proficiency in children with DS (10, 11). In comparison to chronologically age-matched children, the children with DS performed more poorly on tasks requiring balance (i.e., single point standing balance, hopping, walking backwards). In summary, researchers have implied that a program in physical therapy for children with DS must attend to motor learning activities as they relate to ankle joint neuromuscular balance and postural control, continuous practice and repetition, and visual along with kinesthetic feedback (7, 8, 9, 10, 11).

Therapeutic Intervention for Children with DS

Despite the obvious and well documented motor delays and abnormalities in children with DS, no principles or procedures for program development have been devised and implemented that document significant change. Harris was unsuccessful in using neurodevelopmental treatment (NDT) to increase muscle tone and improve motor performance of children with DS (12). Jenkins found no difference between sensory

integrative treatment and motor programming treatment in improving motor performance of a group of perschool children with mild to moderate delays (13).

Dance with physical therapy can motivate awkward children to more independently conduct their own therapy program. Therapists concentrate on facilitating active proximal and trunk movements and the automatic postural reactions that accompany them while children with DS can become totally immersed in the use of the total body concept of dance. Children with DS seem especially motivated and can easily cooperate with the dance and physical therapy program possibly because their rhythmical sense approaches that of normal children (14). The dance approach agrees closely with Shumway-Cook, MacNeill-Shea, and Mezzomo who have suggested that treatment for children with DS be aimed at the improvement of feed forward motor control and the development of strength and neuromuscular balance at the ankle (7, 9).

The medium of dance, therefore, was combined with therapeutic intervention aimed toward development of proximal and trunk control and the experience of moving even if only passively. It was hypothesized that if children with Down Syndrome actually display agonist/antagonist imbalance at the ankle joint, then dance because of its nature, combined with physically therapeutic facilitation would result in improved timed standing balance scores in children with Down Syndrome as compared to a group of control subjects.

METHOD

Subjects

Two separate school-level groups were selected for the study. The groups were equivalent in age in months ranging from 3 years to 14 years (See Table 1). All children were classified by their respective county school boards as trainably mentally handicapped and all were children with DS. All subjects were given the Bayley Motor Scale as part of the selection process to assure their gross motor skill level was at or slightly below the ceiling age of 36 months. Children with DS attending the local school in the instructor's county were the experimental group and an adjacent county group served as the control group. There were 8 females and 5 males in the experimental group. There were 2 females and 8 males in the control group (See Table 1). There were no severe behavioral problems noted by the teaching staffs of either group. Parents and schools were required to sign consent forms. Parents who requested a narrative form explaining test results received one.

Instrumentation and Procedures

Henderson noted that, in general, children with DS could not perform single-point balance skills with their eyes closed (12). Therefore, the single-point items on our balance tests were done with eyes open. The balance test included three timings added together (See Appendix 1).

(1) Timed bilateral toe standing balance

(2) Timed single-point static balance on right lower extremity

(3) Timed single-point static balance on left lower extremity

For each child, a score form was used and testers were prescreened and trained to give the test by the researchers. Interrater reliability

measures demonstrated a coefficient of r = .925. One rater timed the child and gave the test instructions while two other raters observed and scored at the same time. The best time score of each of three trials, one trial in each position, was added to obtain a total skill score in the three balance areas. All students from each group were pretested and all were posttested six months later (See Table 1). Quality deviations on single-point balance were included on the score form. Examples included leaning the non-weight bearing lower extremity against the weight bearing one in such a way as to counter balance oneself to compensate for ankle instability or by posturing the upper extremities and oral musculature in an abnormal manner (See Figures 1 and 2). The non-weightbearing lower extremity was not required to be behind the weightbearing lower extremity.

The dance and physical therapy program was conducted twice weekly for one hour each session in a large room in the school. Equipment included mats, air-inflated rolls, and solid foam rolls or spot trainers, a cassette tape player and tap and ballet shoes for all participants. Each session was divided into warm-up, ballet, and tap or tumbling. During warm-up emphasis was placed on mat activities stressing postural control responses in sitting, kneeling, and half-kneeling. In ballet, techniques such as plie's and port de bra's in first and second position, passe', attitude and releve' were emphasized. Tap dance allowed practice in weight shifts in standing and in single-point balance through use of dance steps like "tap your heel," "your toe," "stomp or shuffle" (See Appendix 2). The children were verbally encouraged to focus their attention on the dance professional and model her words and actions. The

same physical therapist worked in each session with each child who could not accomplish a movement sequence by assuring that each child had tactile brushing, tapping or clapping to facilitate the attainment of static and dynamic trunk and proximal stability during position attainments and transitions. The therapist would also intervene and passively carry a limb through a motion if the child did not initiate the movement. Requirements for facilitation in both areas diminished as the child learned that the idea was to appropriately model the dancer. No intervention was given by the therapist when proximal and distal control were apparent. The therapist attempted at all times to anticipate the individual needs of each child. Songs were added to the dance and movement experiences because singing tended to further motivate the children to respond.

Our dance and physical therapy incorporated tactile guidance, voluntary control, rhythm, and repetition with vision and audition to enhance motor learning. In our program children actively tried to balance, to walk a straight line, and to walk on their toes. Voluntary action and attentional focus on an activity were combined with the facilitation techniques and transitional exercises stressed in neurodevelopmental treatment; challenges to equilibrium were incorporated into all activities. Children repeatedly practiced both static and dynamic balance on a reduced base of support. They were verbally reminded to focus their eyes on one point. When warm-up, ballet, tap or tumbling were done, the same steps were used in each session. For example, if tap was done, toe-tapping, then heel-tapping was followed by a stomp, then a shuffle step. The control group of children remained in

their regular physical education class which stressed ball handling skills and various adapted physical education exercises.

Research Design and Data Analysis

The alpha level was set at .05. Descriptive statistics were generated for original pretest scores and age in months (See Table 1). Equality between groups on both variables was examined using analysis of variance technique on original pretest scores and on age in months (See Table 2). There were significant differences between the two groups on original pretest scores so pretest scores were used as the covariable in an analysis of covariance to determine group differences on posttest scores. Since multiple regression ANCOVA techniques can increase the power of an analysis despite small sample size they were chosen over the gain score technique for this analysis. The analysis of variance showed that age in months was not significantly different between groups (See Table 3); however, original pretest scores were significantly different. In the analysis of covariance using pretest scores as covariable, the experimental group subjects performed significantly better than control subjects in single point and toe standing balance combined scores as shown in seconds on a stop watch (See Table 4, Appendix 1, Tables 2, 3, 4).

Discussion

The value of a combined dance and physical therapy program may revolve around the idea that dance therapy can combine a variety of

therapeutic movement activities. Instead of adhering only to one theoretical approach, we chose to combine several: traditional facilitation techniques as described by Bobath (15, 16), along with motor learning activities and sensory integration techniques as seen through dance technique. The results of this study suggest that the dance and physical therapy program may improve standing balance abilities in children with Down Syndrome. Therapists should consider dance as a modality worthy of inclusion into group therapy programs. Dance, with its inherent practice and rehearsal effects, may remediate deficits in postural control and motor practice as they affect standing balance in children with DS. Dance makes motor practice a motivating and rewarding expereience for normal children and may do the same for children with DS if proper facilitation can be offered by the physical therapist (17).

Conclusion

We chose the sensory and motivationally stimulating mediums of music and dance, coupling them with therapeutic modalities of tactile brushing, tapping, clapping, and passive range of motion to encourage the development of postural control and ability to model another person. The program created an effective improvement in static single point and bilateral toe standing balance scores in a sample of school-aged children with Down Syndrome.

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TABLE 1
Descriptive Statistics

	Sex	Age in Months	Pretest Score (Combined Balance Scores)	Posttest Score (Combined Balance Scores)
Control:	M	66	30	45
	M	51	51	44
	M	66	63	50
	M	141	37	38
	M	167	43	45
	M	96	47	46
	M	170	17	13
	M	86	30	16
	F	106	53	38
	F	118	43	25
$\bar{X}$ =		106.7[a]	43.4[b]	36.0
Experimental:	M	122	35	48
	M	153	26	33
	M	151	32	49
	F	168	6	11
	M	88	49	54
	F	86	44	54
	M	163	6	10
	F	154	8	11
	F	145	42	46
	F	78	29	40
	F	92	51	61
	F	47	34	49
	F	35	46	52
$\bar{X}$ =		114[a]	31.4[b]	39.8

[a] - Age in months means were not significantly different.

[b] - Pretest score means were significantly different ($p < .05$).

TABLE 2 — Descriptive Statistics
Combined Standing Balance MeanScores for Control and Experimental Groups

	$\overline{X}$ Age	$\overline{X}$ Pretest	$\overline{X}$ Posttest
Control (n = 10)	106.7 months	43.4	36.0
Experimental (n = 13)	114.0 months	31.4	39.8

TABLE 3
Anova Table: Original Pretest Score Difference
Between Experimentals and Controls

Source	DF	SS	MS	F
Pretest Scores	1	164.6	164.6	4.09*
Error	21	845.9	40.3	
Total	22	1010.5		

* ($p < .05$)

TABLE 4
Ancova Table: Using Pretest Scores as Covariable

Source	DF	SS	MS	F
Group/Pre	2	735.9	367.9	26.9*
Error	20	273.1	13.7	
Total	22	1009.0		

(* $p < .0001$)

APPENDIX 1
Test for MAT
Timed Standing Balance Tests
Upright Balance--Toe Standing

Objective: To evaluate balance, strength, and equilibrium strategy.

Procedure:

1. Demonstrate toe standing to the count of ten to the child.
2. Ask the child to stay on his or her toes for as long as possible while you count. Feet should assume the same distance as during normal stance. Do not help the child assume the position.
3. Repeat three times and record below the best score using the test form key.
4. Repeat standing on each leg three times and again record below the best score.
5. Stand near to closely guard the child.

Observation/Rationale:

Observe: Position of foot. Test of bilateral toe standing balance ends when the entire foot contacts the floor. Test of unilateral standing ends when child touches upper leg to the floor.

Rationale: These are measures of the active equilibrating capacity of the child. These activities determine whether the child can adjust to very slight changes in the center of gravity (which is never static). The base of support is decreased in unilateral standing activities in order to further challenge balance.

Timed Balance Tests	Total Seconds
A. Toe Standing)	
)	_____
B. Unilateral Standing--Right)	
)	
C. Unilateral Standing--Left)	_____
* Quality Deviations: _____	

* Deviations include leaning non-weight bearing lower extremity against the standing lower extremity, oral motor overlay, and associated movements.

* All trials were timed by a stopwatch and the totaled time was entered into the box on right of form under otal seconds.

APPENDIX 2
Dance Activities
Alignment, Weight Shift, and Balance Activities Offered in Dance Therapy

Techniques	Purpose	Type of Activity	Examples
Warm-up	To prepare muscle response to gravity	o Transitions(emphasis is on weight shifts in sitting, triped kneeling, half-kneeling o Midline sitting and tilting movement components	o Pretzel--pushing up from side sitting with bottom arm and crossing top leg over bottom straight leg o Reaching from side sit out and up
Ballet	To prepare for movement skills Slow graded upper and lower extremity movements with a stable trunk and neutral pelvis	o Extremity strengthening o Cervical and trunk elongation o "Push down to rise up." We encourage children to push down thru their heels in rising from plie to force hip extensors and adductors to assist in neutralizing the pelvis.	o Plies, Passe' o Attitude o Port de bras
Tap	To enhance proprioceptive and auditory cues	o Weight shifts in standing, single-point balance in upright	o Heel tap, toe tap o Shuffle o "Make noise" (a stomp, stomp step) o Ball-Change (a stomp, stomp step in tandem) o Forward over a large air inflated roll or backward over the roll, balancing or in the rolls (balancing can be done in supine, kneeling and quadriped on the rolls)
Songs	To accompany movement verbal expression	o Singing while dancing	o Yankee Doodle Music: George M. Cohan. The Album, Bicentellial Gold (Tap Routine) o Dragon-Achoo. From the album Monsters & Monsters Things: Kimbo Records (warm-up) o A Child's Ballet Prayer Al Gilbert-Dick Parker #469-A (Ballet)

Fig. 1. Standing balance with overflow in oral and upper extremity musculature along with leaning lower extremity against supporting lower extremity.

Fig. 2. Standing balance obtained with therapist assistance to counter-balance a possibly weak head, neck, trunk reaction in standing.